UTAH DEPARTMENT OF TRANSPORTATION

RESURFACING, RESTORATION AND REHABILITATION (3R)

STANDARDS FOR NON-FREEWAY SYSTEMS

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INTRODUCTION

The primary purpose of Resurfacing, Restoration, and Rehabilitation (3R) projects is to provide a better riding surface, enhance safety, improve operating conditions, and preserve and extend the service life of existing non-freeway projects. Develop and design projects that identify and incorporate safety improvements. Economic considerations are also a major factor in determining the priority and scope of 3R projects.

3R projects include resurfacing, pavement structural and joint repairs, widening of lanes and shoulders, minor alterations to vertical and horizontal alignment, bridge repairs, and removal or protection of roadside hazards.

Factors influencing the scope of a 3R project:

1. Roadside conditions
2. Funding constraints
3. Environmental concerns
4. Changing traffic and land use patterns
5. Surface deterioration rate
6. Accidents or accident rates

3R-type improvements are normally made within the existing right-of-way but to carry out the necessary improvements, additional right-of-way may be considered.

3R-Design Exceptions

It may be appropriate and cost effective to deviate from the following design guidelines if properly analyzed and justified. These deviations will require approval of the UDOT Preconstruction Engineer and must be supported by engineering analysis.

Definitions

The following definitions apply:

Maintenance - Maintaining the existing roadway and related appurtenances as necessary for safe and efficient operation and to control the natural deterioration of the pavement (see "Pavement Management and Pavement Design Manual"). Design improvements are not the normal intent of maintenance operations. Pavement repairs such as seal coats, full width patching, crack sealing, thin plant mix resurfacing for sealing of the pavement surface, correcting minor surface irregularities, etc., are generally considered maintenance activities. This work is not considered a 3R activity.

Resurfacing - Application of a new or recycled layer or layers of pavement material to existing pavements to provide additional structural integrity or improved rideability.

Restoration - Rebuild or bring back the original design capability of the facility. This may include minor pavement widening, addition of paved extensions, other drainage improvements, correction of superelevation, and other safety improvements. Generally, restoration activities are confined within the existing right of way.

Rehabilitation - Reconstruction of limited portions of the project's length in order for the facility to better serve existing and short term traffic requirements. Additional right-of-way may be required.

Reconstruction - Fifty percent or more of the project length involves vertical and/or horizontal alignment revisions, bridge replacement, pavement reconstruction, or reconstruction of roadway pavement to provide long-term service. Reconstruction projects are performed in accordance with the appropriate new construction criteria and are not considered to be within the scope of this 3R guide.

Pavement Reconstruction - Reconstruction of roadway pavement including structural modifications to the base material and/or changes in the pavement surface type.

Bridge Preventive Maintenance - Deck repairs, column and cap repairs, parapet repairs, waterproofing decks, painting steel members, and the replacement or closure of deck joints.

DESIGN SPEED

Include a Safety Analysis including an Operation and Safety Report (OSR) on all 3R projects. The OSR must include recommendations for Project Design Speed. Perform the Safety Analysis early in the project development process to identify safety problems. Include both an accident record review and a safety field review documented in the Design Study Report.

Design Speed is the maximum safe speed that can be maintained over a specific section of highway when conditions are favorable.

Identify a design speed to be used in selecting appropriate design elements criteria for the entire section on every 3R project. The design speed is logical and considers the functional class of the road as well as the character of the terrain, advisory curve speed, and posted speed. The speed considerations for a 3R project are different than considerations used for new construction and are based on the ***85th Percentile Speed*****.**

The design speed is equal to or higher than the posted speed. When a design speed is selected that is less than the posted speed, a Design Exception is required.

ALIGNMENT

Horizontal Curves

Document the overall project design speed in the Project Design Study Report. Consider for the report, design speed of all horizontal curves based on project design volumes and accident history at the location.

3R projects include examination of potential hazards at intersections such as power poles, sign poles, and other safety obstacles. Examine sharp horizontal curves and the highway stopping sight distances that fall below standards given in UDOT Standard Drawings.

An existing horizontal curve may be retained as is without further evaluation if:

1. An analysis of accident data at the location is below statewide averages.
2. The appropriate stopping sight distance is provided.
3. The existing curve design including the superelevation is within 25 km/h of the overall project design speed

The Annual Average Daily Traffic (AADT) is less than 750 vehicles per day (VPD).

Apply the following design measures when full reconstruction to UDOT standards is not justified:

1. When the Curve Speed is within 25 km/h of Project Design Speed, the following will apply:
   a. AADT is less than 750 VPD - Review the curve for possible minor improvements. Analyze the curve for possible reconstruction if the horizontal curve is in an area identified as a high accident location (above the statewide average).
   b. AADT is greater than 750 VPD – Reconstruct the curve unless an analysis demonstrates that the reconstruction is not cost effective. The cost-effective analysis must fully address ROW requirements, construction costs, road users' benefits, and accident savings.
2. Superelevation -When the Curve Speed is not within 25 km/h of the Project Design Speed, the existing horizontal curve will be upgraded to current superelevation design criteria

The design measures discussed above are summarized in the table below:

Horizontal Curve Improvement

Curve Design Speed (D.S.) AADT	***25 kph Lower than Project D.S. < 750 VPD***	***25 kph Lower than Project D.S. > 750 VPD***	***within 25 kph of Project D.S. < 750 VPD***	***within 25 kph of Project D.S. > 750 VPD***
Super*	U	U	M	M
Alignment*	MI / R	R	M	M/R

U = Upgrade Super Elevation to Current UDOT Standards
M = Mitigate for Existing Substandard Design Elements
MI = Minor Design Improvements other than Reconstruction
R = Reconstruct Horizontal Curve to Current UDOT Standards Based on Cost/Benefit Analysis
* High Accident Locations Must be Analyzed for Reconstruction to Current UDOT Standards

Consider with any improvement that does not meet overall project design speed, the mitigation measures listed below:

1. Traffic control devices (chevron signs, curve signs, advisory speed signs or delineations)
2. Shoulder widening
3. Curve widening
4. Appropriate superelevation
5. Slope flattening
6. Pavement friction improvement
7. Driveway relocation
8. Obstacle removal

Vertical Curves

The Project Design Study Report will document the overall project design speed, the design speed of all vertical curves based on minimum stopping sight distance, AADT, and accident history at the location.

Based on the stopping sight distance provided, an existing vertical curve may be retained as is without further evaluation if the existing curve design speed corresponds to a speed that is within 30 km/h of the overall project design speed, and the AADT is less than 1,500 VPD.

Reconstruction of crest and/or sag vertical curves to UDOT standards will be evaluated when:

a. The AADT exceeds 1,500 VPD.
b. The design speed (based on stopping sight distance) is more than 30 km/h below the overall project design speed.

c. The vertical curve hides a major hazard such as intersections, sharp horizontal curves, or a narrow bridge.
d. The vertical curve is identified as a high accident location (above the statewide average)

The table below summarizes design measures discussed above.

Vertical Curve Improvement

Design Speed(D.S.) AADT	***Lower than Project D.S. < 1500 VPD***	***Lower than Project D.S. > 1500 VPD***	***Within 30 kph of Project D.S. < 1500 VPD***	***Within 30 kph of Project D.S. > 1500 VPD***
Alignment*	MI / R	R	M	MI /R

M = Mitigate for Existing Substandard Design Elements
MI = Minor Design Improvements other than Reconstruction
R = Reconstruct Horizontal Curve to Current UDOT Standards Based on Cost/Benefit Analysis
* High Accident Locations Must be Analyzed for Reconstruction to Current UDOT Standards

Apply appropriate safety and other mitigation measures if the curve reconstruction is not justified, or the curve is reconstructed to less than new construction standards. Safety measures for crest vertical curves that are less costly than reconstruction include but are not limited to those listed below:

a. Traffic control devices (chevron signs, curve signs, advisory speed signs, or delineations)
b. Shoulder widening
c. Driveway relocation
d. Fixed-hazard removal

Do not ignore substandard sag vertical curves. Eliminate potential hazards including hazards that become apparent when weather conditions or darkness reduces visibility.

Routinely examine the nature of potential hazards when designing such as:

a. Intersections
b. Sharp horizontal curves
c. Narrow bridges hidden by a vertical curve

Consider the hazard location in relation to the portion of the highway where sight distance falls below new construction standards and other options to reconstruction such as relocating, correcting the hazard, or providing warning signs.

Curves in Series (Horizontal and Vertical)

Frequently the alignment of a segment of a roadway consists of a series of reverse curves or curves connected by short tangents. A succession of curves may be analyzed as a unit rather than as individual curves applying the above criteria.

Give special attention to the first substandard curve in a series of substandard curves. This change in alignment prepares the driver for the remaining curves in the series.

Individually analyze each intermediate curve in a series of substandard curves that is 15-25 k/hr less than other curves in a series.

Use the controlling curves to determine the safety and/or other enhancement measures to apply throughout the series (see “Safety Enhancements,” pg. 11).

Evaluate the series of curves as a whole when improvements are considered to any curve in a series.

LANE AND SHOULDER WIDTHS

Wide lanes and shoulders provide motorists increased lateral separation between vehicles. They also provide for less interruption of the traffic flow as a result of emergency stopping and maintenance activities. Paved shoulders provide lateral stability of pavement. Lane widths less than 3.3 meters severely reduce the lane capacity of roadway. Narrow travel lanes generally cause drivers to crowd the center lines and can influence the overall accident frequency.

The 3R project will not reduce the overall pavement surface when the lane width is less than the full design standard. Design lane width to current UDOT Design Standards.

The table below contains in-place minimum and desirable shoulder widths. Widen shoulders less than the in-place minimum to the desirable width.

	In-Place Minimum Shoulder Width				Desirable Shoulder Widths			
	ADT				ADT			
	Under 400	400 To 1500	Over 1500 To 2000	2000	Under 400	400 To 1500	Over 1500 To 2000	2000
Local Road	(M)	(M)	(M)		(M)	(M)	(M)	(M)
Collector Road	(M)				.6	1.5	1.8	
Minor Arterial	(N).3	.6			2.4			
Principal Arterial	.6		1.2		.6	1.5	1.8	
	(O).3	.6			2.4			
	.6	1.2			1.2	1.8	1.8	2.4
	(P).6	.9			1.2	1.8	1.8	2.4
	.9		1.2					
	(Q).6	.9						
	.9		1.2					

BRIDGE WIDTH VERTICAL CLEARANCE AND STRUCTURAL CAPACITY

UDOT Criteria on Bridge Width and Structural Capacity:

Minimum acceptable bridge widths:

Bridge Widths

Design Year Volume (ADT)	Usable Bridge Width (m)
0 - 750	Width of approach lanes
751 - 2000	Width of approach lanes plus 0.6m
2001 - 4000	Width of approach lanes plus 1.2m
Over 4000	Width of approach lanes plus 1.8m

Note: If lane widening is planned as part of the 3R project, compare the usable bridge width to the planned width of the approach lanes after they are widened.

No clear roadway width will be less than 6 meters across any structure. Upgrade or mitigate approach guardrail and existing bridge rail and guardrail connections to meet the current UDOT Standards. Meet all MUTCD requirements including upgrading signing, pavement markings, hazard panels, and any other related safety measures Consider alternative safety measures including traffic control devices, approach guardrail, hazard markings, and pavement markings when a narrow bridge is a geometric deficiency.

Maintain the minimum load carrying capacity of existing bridges that will not be rehabilitated to sufficiently carry school buses and vital service vehicles where there is not an acceptable alternate route. A maximum depth of 80 mm of pavement is allowed on bridge decks.

Vertical Clearance

Maintain existing vertical clearance for bridges between 4.3m and 4.9m. Bridges with less than 4.3m clearance will be mitigated.

GRADES AND CROSS SLOPES

Grades

Unless grade changes are in conjunction with vertical curve reconstruction, existing grades will remain. Consider flattening grades to provide climbing lanes or run away truck ramps if high accident rates are a result of steep grades.

Cross Slope

Snow plow and ice clearance operations require that appropriate drainage be provided for safety. Restore all roadways to 1.5 – 3 percent cross slope (crown). Rotomill or level any settling or rutting roadway prior to new pavement overlay. Projects that do not restore the minimum cross slope will require a design exception. In no case will the maximum super elevation exceed 6 percent.

SIDE SLOPES AND CLEAR ZONE

Accident data firmly establish that roadside characteristics are important in determining the overall level of safety provided by a highway. Accident rates are lower and accidents are less severe on highways with few obstacles near the travelway.

Clear Zone

For safety purposes, provide a roadside recovery area that is as wide as practical. The Project Manager will determine a uniform clear zone for the project, taking into account the characteristics of the highway as well as adjacent segments. An evaluation will determine if any existing conditions interfere with the clear zone and the severity of each situation. Use the clear zone requirements in the AASHTO Roadside Design as a guide. The Operation Safety Report (OSR) will address the acceptable clear zone. **The Project Manager must coordinate the clear zone criteria with Traffic and Safety before the concept meeting.**

Use good judgment when working with existing topographic features and right-of-way limitations associated with 3R work. Evaluate roadside features and improved if justified by a benefit cost analysis. Mitigate roadside features or obstacles within the clear zone by removal, relocation, shielding, or reconstructing to a breakaway design.

Side Slopes

Flatten side slopes as recommended in the OSR on slopes 1:3 or steeper at locations where run-off-road accidents are likely to occur such as on the outside of sharp horizontal curves. Retain current slope ratios (do not steepen side slopes) when widening lanes and shoulders unless warranted by special circumstances.

INTERSECTIONS

Pay special attention to intersections because accidents frequently happen there. Individually analyze all intersections with a higher than expected accident history and include improvements in the 3R Project.

Intersection Safety Review – The analysis will include but not be limited to the following items as justified by accident history:

1. Leg alignments
2. Pavement marking improvements including long-wearing and delineation
3. Sight distance improvements
4. Surface treatments to improve skid resistance
5. Additional or extension of auxiliary lane
6. Flatter curve radius
7. Signing review
8. Pedestrian
    a. Higher visibility crosswalks (paint, signing, etc.)
    b. Pedestrian signal with pushbuttons (if at signalized intersection)
    c. Disabled pedestrian ramps
    d. Traffic Signal Review
    e. Signal head locations and size
    f. Visibility of displays
    g. Upgrade to mast arms
    h. Modify phasing

SAFETY ENHANCEMENTS

One purpose of a 3R improvement is to correct an existing or potential safety problem. Weigh the cost of any improvements against potential accident reduction. In a number of circumstances it is necessary to provide a safety benefit cost analysis of the potential improvements including but not be limited to the following:

1. Skid resistance
2. Pavement edge drop-off
3. Drainage
4. Bicycle access
5. Rumble strips
6. Delineation
7. Channelization
8. Approach grade
9. Alignment
10. Bridge rail improvements (new bridge rail or bridge retrofit)

REFERENCES

1. Designing Safer Roads - (Special Report 214), TRB 1987.

2. Technical Advisory - Developing Geometric Design Criteria and Processes for Non-freeway R-R-R projects (T5040.28), FHWA 1988.

3. A policy on Geometric Design of Highways and Streets, AASHTO 1994.

4. Roadside Design Guide, AASHTO 1996.

5. North Carolina Department of Transportation R-R-R guide, May 1992.

6. New Mexico State highway and Transportation Department, Geometric Design for Resurfacing, Restoration and Rehabilitation, (revised March 25, 1993).

7. Colorado Department of Transportation, Procedural Directive, Safety Considerations on resurfacing & 3R Type Projects. 1999

8. Wyoming Transportation Department, 3R Criteria For Collectors 1995.

9. Idaho Department of Transportation, GUIDELINES FOR 3R IMPROVEMENTS - NATIONAL HIGHWAY SYSTEMS, 1994.